IET International Travel Award 2023 – Travel Report – David Magee

I have just completed an 11-week summer internship in the USA at Argonne National Laboratory, Illinois, for which I received an International Travel Award from the IET to help with travel costs. I can safely say that it was the most amazing, eye-opening, and engaging experience I have ever undertaken. I feel like my future career has truly kickstarted. I am feeling confident and excited to return to the UK to begin the final year of my 4-year MEng Nuclear Engineering degree at Lancaster University, as I know exactly what I need to work towards to get to where I want to be as a professional.

Over the summer I worked as a Research Aide in the Chemical and Fuel Cycle Technologies division at ANL. I worked on a project in relation to the molybdenum-99 (Mo-99) program, the world's most widely used medical radioisotope. The daughter radioisotope of Mo-99, technetium-99m (Tc-99m), is used in over 80% of all nuclear medicine procedures today for imaging and diagnosis, ultimately enabling thousands of lives across the globe to be saved. It was truly an amazing experience to be able to work on something that has such a huge impact on the world, and in somewhere as prestigious as ANL which is so rich with historical and pivotal innovations. I ended up extending the internship for an extra two weeks as I was so engaged.

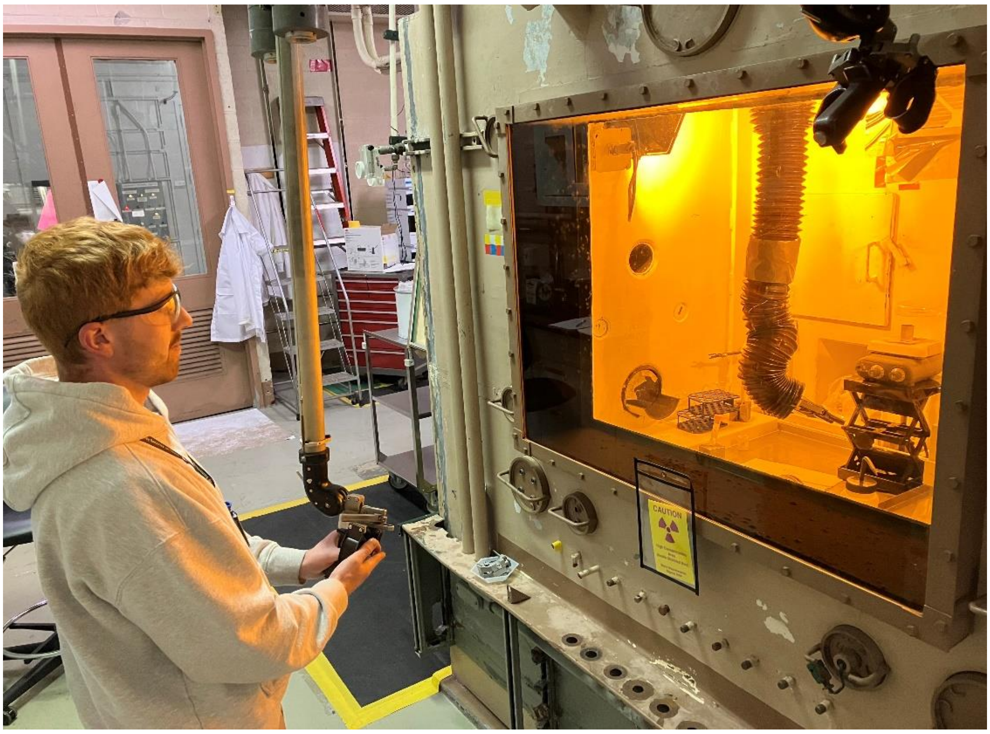
My project entailed optimizing the chemical purification process of a Mo-99 product for commercial production of this medical isotope in the US. To give an overview of the process, low enriched uranium (LEU) targets are first irradiated in a superconducting electron linear accelerator (LINAC). This produces Mo-99 along with various other fission products. This is followed by several chemical purification and Mo-99 concentration steps, including dissolution, uranium extraction (TBP-based process), Mo liquid-liquid extraction (MoLLE), and finally an anion-exchange column (concentration column) that yields a highly pure medical grade Mo-99 product. Note the use of LEU, in which there has been a huge recent surge of interest in as it eliminates the use of high enriched uranium (HEU). HEU carries serious proliferation risks and has traditionally been used to produce Mo-99. As of now, all major Mo-99 producers have converted to non-HEU targets.

I specifically focused on the concentration column element of the process and optimizing it. This final purification step removes trace quantities of fission product impurities, producing a pure Mo-99 stream, suitable for nuclear medicine applications. This step uses a chromatography column containing an anion-exchange resin that has a high affinity for adsorbing Mo anions. The column is loaded with the Mo-99 containing stream from the previous MoLLE stage, and Mo-99 adsorbs on to the resin. Several wash solutions then follow that remove and flush out fission product impurities, and a final wash solution strips Mo-99 from the resin. A pure Mo-99 product is then collected.

As forementioned, my work involved optimizing this process. To do this, I performed batch test tube studies that yielded the necessary parameters for the design of a full-scale column for optimized Mo-99 recovery and that meets purity specifications. In this work, I used a Mo-99 radiotracer, obtained from a Mo-99/Tc-99m generator that is typically used in radio-pharmacies. In doing this, I developed essential radioactive material handling skills that are paramount in this industry. Radioactive waste was of course generated in doing this work, and I further learned how to correctly deal with it and how to prevent the spread of contamination. I also greatly improved on wet chemistry techniques and knowledge. Throughout my Nuclear Engineering degree at Lancaster, I have not had many opportunities to develop general chemistry or radiochemistry skills, so this internship was a great way to gain hands-on experience in that field and I thoroughly enjoyed and efficiently adapted to it. I also regularly used a NaI gamma detector to measure sample activities, which is an invaluable skill to possess in this industry. The data I produced in my work was extremely promising and is to be used in future related studies.

Throughout my time at ANL, I worked with some of the most talented and impressive individuals in the industry. My mentor, supervisor, and other lab colleagues could not have been nicer or welcoming, and taught me so much over the summer. They truly helped me in developing myself as an individual and making me better understand what I want to do as a career and what a life in it would be like. I also presented my work to them on several occasions, and received a lot of feedback and constructive criticism which I have taken on board and will strive to improve on going forward.

This experience would not have been possible, however, without the sincere generosity I received from the IET through their International Travel Award. I was fortunate to be awarded a substantial financial award to help with travel expenditures, including transport and accommodation. A summer spent in the US living in Chicago, which is close to the laboratory, is an inherently expensive experience, even when receiving a full-time wage. This award relieved a lot of the financial stress that I was feeling in the weeks leading up to travelling to the US. Ultimately, this enabled me to work to my full capabilities, and moreover to enjoy my time in the US. Chicago is an amazing city with so much to do and see, and being able to enjoy this on top of everything else was incredible. I was also fortunate to take a trip to New York at one stage, which was brilliant. This encouraged me to work even harder. I would highly recommend anyone that is reading this and is travelling to apply for a Travel Award through the IET, and to get membership if you haven't already done so. It helped me out so much and I am extremely grateful for it, and I would love for others to feel the same.




CAUTION
Radiation Area
(Inside Hood)
LSC VIAL
GLASS VIAL
FLAMMABLE


WESTIN